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Partial Fragmentation Projectile with Penetrator in the
Projectile's Nose

The invention relates to a partial fragmentation
5 projectile according to the pre-characterising part of the
first claim.

The effect of a projectile, particularly for hunting
purposes, within the body of the quarry is substantially
10 dependent on the mass of the said projectile, the
characteristics of its material and its design structure.
Partial fragmentation projectiles exist, for example, H-
jacket projectiles and torpedo ideal projectiles, which
contain two cores. If lead cores are used, the so-called
15 nose core, facing the tip of the projectile, consists of a
relatively soft alloy and the core at the rear, the so-
called rear core, consists of a harder alloy. When
striking and penetrating the quarry it is primarily the
front part of the jacket of the projectile and the softer
20 nose core which fragments into splinters.

The rear core, consisting of the harder alloy, forms the
remainder of the projectile. This gives rise to the depth
effect and should emerge from the quarry, forming an exit
25 hole. In so-called hard hits, for example, if the
projectile strikes bone, the jacket of the projectile tears
open in some circumstances beyond the dividing line between
the two lead cores. This normally leads to a total
fragmentation of the nose core and to severe splintering of
30 the jacket of the projectile. This results in serious loss
of mass by the projectile and not insignificant deformation
of the rear core, even extending to fragmentation of this.
This can result in the loss of so much energy that it is no
longer possible for the remainder of the projectile to
35 emerge from the quarry.

The object of the present invention is to initiate a rapid fragmentation of the jacket of the projectile when it strikes the quarry and to ensure an exit with the projectile having a defined residual size. The solution to 5 the problem is provided with the aid of the characterising features of the first claim. Further advantageous embodiments of the invention are described in the subclaims.

- 10 Unlike conventional partial fragmentation projectiles, the projectile according to the invention is constituted such that the nose core, as penetrator, consists of the harder material and is arranged in front of the softer core when seen in the direction of the trajectory of the projectile.
- 15 As a consequence of its design, the projectile according to the invention achieves a multiple effect within the quarry. Since there is little fragmentation and therefore less loss of mass, the penetrator arranged on the nose side and made of a harder material than the projectile core achieves a
- 20 reliable exit even if there is increased resistance in the quarry. The shaping of the rear of the penetrator and the shaping of the nose of the projectile core being harmonised with the fragmentation characteristics required for the projectile core depending on the calibre, the impact speed
- 25 and the nature of the quarry causes a compression and wedge effect, harmonised with each other, to be exerted on the projectile core to fragment it. The fragmentation of the projectile core already takes place when it penetrates into the quarry in such a way that the splinters are preferably
- 30 directed into the immediate area of the entry channel. Readiness to fragment is supported by the use of an easily deformable material such as, for example, tin or zinc.

The fragmentation of the softer projectile core is defined 35 substantially by the design of its nose. If there is a

conical recess central to the axis of the projectile, there is a strong splitting effect. The cone angle must be harmonised with the hardness of the material of the projectile core and the fragmentation effect required. The harder the material is and the greater the angle, the greater is the tendency to fragment into small splinters. If a soft material and acute angle are used, breaking open in strips, mushrooming out and fragmentation into large splinters predominate. The angle is between 30° and 90°, preferably approximately 60°.

If the nose of the projectile core has a depression-shaped recess, fragmentation into splinters is initiated predominantly by a deformation of the nose of the projectile core because of the initially greater resistance on penetrating into the quarry.

The tendency to fragment into splinters can be increased substantially, even to complete fragmentation, if a cavity central to the axis of the projectile, for example a bore, adjoins the respective recess. This bore may be cylindrical or tapered and may have a depth and a diameter appropriate to the fragmentation required. The deeper the cavity is, the greater is the tendency for the projectile core to fragment into splinters when penetrating the quarry. The larger the diameter is, the smaller the remaining proportion of material is in the projectile core and the more easily it fragments into splinters. The cavity may extend for up to approximately $\frac{1}{3}$ of the length of the projectile core.

Just as the design of the nose of the projectile core substantially determines its tendency to fragment, naturally the rear side of the penetrator, which, moreover, consists of a harder material, is the significant tool in

determining the course of the fragmentation of the projectile core.

The rear of the penetrator may have a conical tip, whereby
5 the cone angle and the acute angle of the conical recess in
the projectile core are harmonised with each other. A
conical rear to the penetrator acts like a wedge on the
projectile core and, here too, the same applies as has
already been explained in the description of the design of
10 the nose of the projectile core.

If, in contrast, the rear of the penetrator has a spherical
shape, the projectile core is subjected to serious
deformation initially before it is torn into splinters
15 because the stress on the material exceeds its yield point.

The deformation effect of the penetrator is given
additional support if the conical tip or the spherical
shape at the rear of the penetrator and, as a mirror image,
20 the recess in the nose of the projectile core, are
surrounded by a circular annular surface, these surfaces
being perpendicular to the midline of the projectile.

The shape of the tip of the projectile has a substantial
25 influence on the characteristics of the projectile in
flight and its penetration characteristics when entering
the quarry and the fragmentation behaviour of the jacket.

If a region surrounded by the jacket of the projectile is
30 situated in front of the nose side of the penetrator and if
the tip of the jacket is not closed, the characteristics of
the projectile in flight are not so advantageous as when
the aperture in the jacket is closed by a tip. This tip
can take the form of a projectile cover of thin, soft sheet
35 metal or a solid tip. A closed tip gives the projectile

less air resistance because of the more regular pattern of the flow lines.

The shape of the tip of the projectile also has an influence on the fragmentation of the jacket. Conditions similar to those found in a hollow tip projectile are found with an open tip or if the projectile cover consists of soft sheet metal. When the said projectile strikes the quarry, the jacket is torn open in strips immediately. If 10 the tip is solid, the projectile will penetrate into the quarry first of all and the fragmentation of the jacket will be initiated by its severe deformation by the tip thus causing the yield point of the material to be exceeded.

15 In contrast to the penetrator, the tip of the projectile consists of a softer material. It is advantageous if this tip of the projectile is manufactured, for example, from a biodegradable plastic. Shaping a plastic is simpler and cheaper than the manufacture of a solid projectile tip 20 consisting of metal. The residue of the tip of the projectile remaining in the animal's body or dropped in the countryside is biologically harmless.

The design of the nose of the penetrator in turn has an effect on penetration resistance in the quarry. If the 25 nose of the penetrator is a flat head, only a slight deformation of the nose of the penetrator is initiated. If the nose takes the form of a hollow tip, for example via a funnel-shaped recess, optionally with a cavity adjoining 30 it, a more severe deformation is initiated. This causes the penetration resistance in the quarry to be increased and achieves a greater dissipation of energy because of the increase in diameter.

The projectile according to the invention has a sharp edge. A sharp edge ensures a clean point of entry into the skin of the game concerned. This is not torn but rather is punched out on entry. The entry aperture, which is 5 approximately the same size as the calibre of the ammunition, therefore already ensures that the wound produces blood on entry of the ammunition.

A sharp edge is preferably present at the point from which 10 the diameter of the projectile no longer increases when looking at the projectile from the nose. In the projectile according to the invention, the sharp edge is positioned at the transition point between the penetrator and the projectile core. The penetrator consists substantially of 15 the narrowing part of the projectile, whilst the projectile core forms the cylindrical part of the projectile. In this type of projectile, the sharp edge also functions as a predefined fracturing point for the jacket. The penetrator is separated from the projectile core when the strips of 20 the projectile jacket break off, at the latest at the sharp edge.

The wall thickness of the projectile jacket influences the rupturing process and the degree of splintering off. 25 Therefore the wall thickness of the jacket decreases in the area of the projectile core in the direction of the narrowing region of the projectile. There is a jump in the thickness of the wall at the sharp edge, i.e. the wall thickness in the region of the penetrator is less than in 30 the area of the projectile core. A lesser wall thickness favours the fragmentation of the projectile jacket into splinters.

It is particularly advantageous if the projectile, 35 consisting of its jacket, the penetrator and the projectile

core and the projectile cover, if present, or the tip, consist of lead-free materials. Since lead and its alloys are deemed toxic, the tissue into which splinters of lead have penetrated is only considered edible to a limited extent. If, in contrast, in accordance with the invention, materials are used for the projectile such as plastic, for example, and the metals copper, tin, zinc, iron, tungsten, titanium, silver, aluminium, tantalum, vanadium plus possible alloys of the metals listed, the splinters penetrating into the tissues are harmless and cause no toxic contamination of the tissue.

The invention is explained in greater detail using exemplifying embodiments.

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Figure 1 shows a partial fragmentation projectile according to the invention with a penetrator in the nose of the projectile,

20 Figure 2 shows a projectile tip as a hollow tip which is sealed by a metal cap,

Figure 3 shows a projectile tip as a hollow tip which is sealed by a solid tip,

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Figure 4 shows an example of an embodiment of the nose shape of the penetrator, here with a flat nose,

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Figure 5 with a conical recess in the nose and Figure 6 shows an exemplifying of an embodiment of the rear shape of the penetrator and the corresponding nose shape of the projectile core, in this case with a penetrator with a conical rear, the cone and

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the conical recess each being surrounded by a ring-shaped surface,

Figure 7 shows an assemblage of a penetrator with a
5 spherically-shaped rear and a projectile core with
a hollow recess and

Figure 8 shows a penetrator with a rear with a bell-shaped
tip and a projectile core with a correspondingly
10 shaped cut-out.

A partial fragmentation projectile 1 according to the invention is shown in half-section in Figure 1 enlarged many times. A nose core 3 and a rear core 4 are surrounded 15 by a jacket 2. The nose core 3 is the penetrator according to the invention and consists of a material which is harder than the rear core 4, which forms the projectile core.

The projectile possesses a hollow tip 5. The aperture 6 of 20 the jacket 2 can be sealed by a projectile cover or a solid tip as is shown in Figures 2 and 3 which follow.

The nose 7 of the penetrator 3 has a conical recess 8 with a cylindrical bore 9 adjoining it. As has already been 25 described, the shape of the nose of the penetrator influences its deformation behaviour when striking the quarry.

The narrowing part 10 of the projectile 1 is substantially 30 formed by the penetrator 3. Its rear 11 tapers to a point and extends into the cylindrical part 12 of the projectile 1. The cone angle 35 must be harmonised with the hardness of the material of the projectile core 4 and the desired effect of the fragmentation of the said core. The harder 35 the material and the greater the angle 35, the greater is

the tendency to fragment into small splinters. If the material is soft and the angle 35 is acute, breaking open into strips, mushrooming out and fragmentation into large splinters predominates. Therefore the cone angle 35 is 5 between 30° and 90° approximately, preferably approximately 60°. The projectile core 4 ~~possesses~~ a bore 14 with a conical pattern initially at its nose 13 to hold the conical rear 11 of the penetrator 3. This is connected to a considerably narrower cavity 15 with a slightly tapered 10 shape which extends approximately to the centre of the rear core, the projectile core 4. When the projectile 1 strikes the quarry, the penetrator 3, consisting of a relatively hard material, will act like a wedge with its conical rear 11 on the projectile core 4, which consists of a 15 substantially softer material, such as tin or zinc, for example. The cavity 15 is advantageous to the tearing open process and therefore to the further fragmentation of the projectile core 4 into splinters.

20 The jacket 2 is in contact with both the conical rear 11 of the penetrator 3 and the ring-shaped face surface 18, which surrounds the tapered bore 14 in the projectile core 4 on the face side. A crimping 17 is pressed into the jacket 2 at the point where a part of the cone 11 projects from the 25 cylindrical projectile core 4. The front surface 18 of the projectile core 4 is set back from the midline 19 of the projectile 1, a sharp edge 16 being produced in the jacket 2. When passing through the skin of the game it produces a clean entry aperture with a sharply delineated edge.

30 The crimping 17, with which the sharp edge 16 is formed, causes the fragmentation of the projectile 1 in the penetrator 3 and the projectile core 4. When the projectile jacket 2 tears open, the sharp edge 16 acts as a 35 preset breaking point. The strips of the jacket 2, which

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are fragmenting into splinters, tear off at this point at the latest. The separation is also made easier by the wall thickness of the jacket reducing between the rear of the projectile 20 and the sharp edge 16. The wall thickness of 5 the jacket 2, which surrounds the narrowing part of the projectile 1, continues in approximately the same, reduced wall thickness to the aperture 6 of the hollow tip 5.

Figures 2 and 3 illustrate two exemplifying embodiments of 10 the design of the projectile tip 21. In Figure 2 the opening 6 of the jacket 2 for the hollow tip 5 is closed by a projectile cover 22. In the present embodiment of the invention, this is a metal cap with a small wall thickness made of a considerably softer metal than the jacket 2. The 15 projectile cover 22 closes the aperture 6 and thus improves the aerodynamic characteristics of the projectile 1. When it strikes a quarry, the projectile cover 22 is deformed slightly. This only acts insignificantly on the jacket 2 and the penetrator 3 so that the deformation and the 20 fragmentation of the jacket 2 is only initiated on impact.

In Figure 3 the aperture 6 in the jacket 2 is closed by a solid tip 23, to the conical body of which a shaft 24 is connected which is inserted in the cylindrical bore 9 of 25 the penetrator 3. When the solid tip 23 strikes the quarry, the said tip is not deformed substantially at first and therefore penetrates into the quarry before the pressure building up becomes so great that the fragmentation of the jacket 2 is caused by the tip 23 being 30 displaced backwards.

Figures 4 and 5 show further exemplifying embodiments of the shape of the nose 7 of the penetrator 3. These exemplifying embodiments are also suitable for sealing the 35 aperture 6 of the jacket 2 with a projectile cover 22

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according to the embodiment shown in Figure 2. When the flat front surface 25 of the penetrator 3 strikes a quarry, compression of the material is promoted whilst the conical recess 26 according to Figure 5 favours direct mushrooming 5 out. The cone angle 36 corresponds to the usual aperture angle of the tip aperture found in hollow projectiles.

Figures 6 and 7 show further exemplifying embodiments of the design of the rear shape of the penetrator and the 10 corresponding nose shape for the projectile core. In the embodiment according to Figure 6, the rear of the penetrator 3 has a conical tip 27 which is supported by an annular surface 28. This annular surface 28 is also supported by an annular surface 29, which forms the front 15 surface on the nose of the projectile core 4. It surrounds a conical recess 30, which holds the conical tip at the rear of the penetrator 3. Both annular surfaces 28 and 29 are at a right angle 37 to the midline 19 of the projectile 1.

20

When the projectile 1 strikes a quarry, the penetrator exercises two effects on the softer rear core, the projectile core 4. The annular surface compresses the material of the projectile core whilst the tapered tip 25 penetrates like a wedge into the material and tears it apart. Here, too, the cone angle 35 must be harmonised with the hardness of the material of the projectile core 4 and the fragmentation effect required. The fragmentation of the projectile core 4 takes place initially in the 30 presence of massive deformation of the material.

An even stronger compressive effect is achieved when the rear of the penetrator 3 has a round shape 31 as shown in Figure 7. This is connected via a depression-shaped recess 35 32 of the projectile core 4. In the present exemplifying

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embodiment, first of all there is a severe compression of the material of the projectile core 4 followed by exceeding the yield point of the material which finally leads to tearing open and mushrooming out by the projectile core 4.

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The fragmentation of the projectile core 4 according to the present exemplifying embodiments can be accelerated if a cavity in the projectile core 4 adjoins the recess 30 or the trough-shaped recess 32, in each case centred on the midline of the projectile 1, as is the case with the exemplifying embodiment according to Figure 1.

Figure 8 shows an exemplifying embodiment with a bell-shaped tip 33 as the rear of the penetrator 3. It is a tip 15 with a combined compressive and splitting effect which extends into a correspondingly shaped recess 34 of the projectile core 4.